ISSN - Print: 2277 – 1522; Online: 2277 – 3517

REVIEW ARTICLE

DOI: 10.26727/NJRCM.2023.12.1.031-041 Year: 2023 Vol: 12 Issue: 1. Jan.-Dec. Page: 031-041

Artificial Intelligence for Community Health Professionals.

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Date of Submission : 07-07-2022
Date of Acceptance : 24-04-2023
Date of online Publication : 24-07-2023
Date of Print Publication : 31-12-2023

ABSTRACT

Digital health uses technologies to improve health. The article content was synthesized from PubMed, Google Scholar, and other digital resources. Artificial intelligence (AI) is a kind of a technology which has capability to assist in health and other industries. It emphasizes the simulation of human intelligence processes by machines that work and react like human beings and Machine Learning is any process by which a system improves performance from experience. It is a subset of machine learning that enables computers to solve more complex problems. Machine Learning models categorised into Supervised Learning, unsupervised and reinforcement learning. Pythan Languages is a tool which is used to build a AI programme commonly. An algorithm is a set of rules given to an AI program to help it learn on its own. Decision Trees, Support Vector Machine, Naive Bayes Classifier, Genetic Algorithms, and Fuzzy Algorithms have been used to detect and increase the accuracy of the models. The advantages of Artificial intelligence applications are enormous and can revolutionize any professional sector. In the health sector, it is primarily used for screening, monitoring, and diagnostic assistance, AI applications include algorithms that analyse chest X-rays, CT & MRI Scan, ECGs and ultrasound scan, scan pathology slides and even assess fundus images for signs of retinopathy. It helps to make better decision quick and to make new interventions, but it involves huge expense and complex technology. Ensure safety, ethically acceptable, cost-effectiveness and affordability, people-centeredness, evidence-based, effective, efficient, sustainable, inclusive, equitable and contextualized to be considered.

Key word: Artificial Intelligence, Big data, Deep learning, digital health, Machine learning, Python, Health care.

Nat.J.Res.Com.Med. 2023; 12(1). © Community Medicine Faculties Association-2023

INTRODUCTION:

Universal health coverage (UHC) intends to provide full spectrum services, from health promotion to prevention, treatment, rehabilitation, and palliative care to all. [1] The use and scale up of digital health solutions can transform the effort of UHC and empower society to make better-informed decisions about their own health and updates.[2,3,4] Medical health records and health programmatic data are mostly made accessible in digital form. [5,6] These should be used for decision making using big data or other promising tools. A digital tool named Biosense is an example that informs public health professionals on threats identified under Syndromic Surveillance. [7]

Digital information is the bedrock of high-quality healthcare.[8] WHO's classification of digital health interventions (DHIs) categorizes the different ways of the use of digital health through via mobile phones, tablets and computers which includes system challenges of information, cost, efficiency, quality, availability, acceptability, quality, utilization, and accountability. [9] Artificial intelligence (AI) is a kind of a technology which has capability to assist in health and other industries.

Aim and Objectives: To review the basics of Artificial intelligence (AI) technology and its role in health care.

Material and Methods:

The review comprises of collecting information from multiple resources including PubMed, Google scholar and other digital resources and carefully selected the relevant information of digital health. The manuscript is developed to create some insights to public health professionals on the basics of AI.

History of AI

The name Artificial intelligence (AI) was coined by John McCarthy which was called previously as Intelligent Knowledge-Based Systems (IKBS).[11, 12] The British mathematician Alan Turing (1950) was the founders of modern computer science defined the ability of computer to perform cognitive tasks (Turing test). [13, 11] The different terminologies used in digital health is given in **Box 1**.

Box 1. Terminologies used in Artificial Intelligence

Digital health: The field of knowledge and practice associated with the development and use of digital technologies to improve health. mHealth (or "mobile health") is a component of eHealth and involves the provision of health services and information via mobile technologies, such as mobile phones, tablet computers and Personal Digital Assistants (PDAs). The collective term "digital health" encompasses both concepts.
eHealth: is the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge, and research.
Artificial intelligence: An area of computer science that emphasizes the simulation of human intelligence processes by machines that work and react like human beings. Learning is any process by which a system improves performance from experience. (Herbert Alexander Simon).
Machine Learning is concerned with computer programs that automatically improve their performance through experience.
Internet of things: The Internet of things is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to computer interaction.
Big data: The emerging use of rapidly collected, complex data in such unprecedented quantities that terabytes (1012 bytes), petabytes (1015 bytes) or even zettabytes (1021 bytes) of storage may be required. The unique properties of big data are defined by four dimensions: volume, velocity, variety, and veracity. As more information is accruing at an accelerating

In 1975, MYCIN was the first knowledge-based systems to provide consultation and diagnosis for antimicrobial therapy. The other early expert systems were PIP- Present Illness Program (acquires the diagnosis of patients with renal disease), INTERNIST-1- internal medicine diagnosis by modelling behaviour of clinicians, CASNET (Casual Associated Network)- for Glaucoma assessment and therapy, PUFF-Pulmonary function test interpretation.[14 ,15, 16]

Chatbot is computer program designed to simulate conversation with human users, especially over the internet which is communicated through text messages. Eliza (1966), ALICE (1995),2001-

SMARTERCHILD, 2006-IBM'S Watson, 2010-SIRI, 2012-Google Now, 2015-ALEXA, 2015-CORTANA, 2016-Bots for Messenger and 2016-TAY are commonly used Chatbot. Sofia is a human-like robot designed by Hanson Robotics in Hong Kong which was given a Saudi citizenship. [17, 18, 19, 20]

AI in India

India's AI start-up ecosystem is booming with several start-ups working in the domain of machine learning, computer vision and NLP.[21] The applications of AI in the healthcare space will be worth INR 431.97 billion by 2021, expanding at a rate of 40%. [22] The Information Technology Act, 2000, mandate that service providers use the latest technologies. National eHealth Authority (NeHA) - An authority which is responsible for the expansion of the integrated health information system within India. The Integrated Health Information Program (IHIP) is intended to provide EHR to all citizens of India and provide interoperability to existing EHR/EMRs. National digital health mission was also launched in India to digitize health care system. [23] The use of artificial intelligence (AI) has been encouraged in the healthcare sector by government think tank Niti Aayog. The Taskforce on the Artificial Intelligence for economic development constituted by the Government of India to review AI in different domain. [24]

Machine learning and Deep learning

Machine learning is a subset of AI, and it consists of the techniques that enable computers to figure things out from the data and deliver AI applications. Deep learning, meanwhile, is a subset of machine learning that enables computers to solve more complex problems. It is all about using neural networks with more neurons, layers, and interconnectivity. [25]

Machine Learning models generally fall into three different categories which include Supervised Learning, unsupervised and reinforcement learning. Supervised Learning uses linear or logistic regressions and decision tree classification. Unsupervised Learning- uses clustering and association. Reinforcement Learning- Learning is about taking suitable action to maximize reward in a particular situation. [26]

Machine learning is the development of algorithms which can learn from data based on the

Box 2: AI languages[29]

1.Python: It is very simple and can be easily learnt and easier than Java, C++, or Ruby.
TensorFlow is an end-to-end python machine learning library for performing high-end numerical computations. It can handle deep neural networks for image recognition, handwritten digit classification, recurrent neural networks, NLP (Natural Language Processing), word embedding and PDE (Partial Differential Equation). Keras Python offers almost all standalone modules including optimizers, neural layers, activation functions, initialization schemes, cost functions, and regularization schemes. Other types include Theano Python, Scikit-learn Python, PyTorch Python, NumPy Python, Python Pandas, Seaborn Python [30]
2. R: R is one of the most effective language and environment for analysing and manipulating the data for statistical purposes.
3.Lisp. It is one of the oldest and the most suited languages for the development in AI. It was invented by John McCarthy, the father of Artificial Intelligence in 1958. It has the capability of processing the symbolic information effectively.
4.Prolog: The features provided by Prolog include efficient pattern matching, tree-based data structuring and automatic backtracking. PROLOG Logic Programming-Natural language processing, Defines relations to the machines. PROLOG was developed in the 1970s.
5.Java: Java can also be considered as a good choice for AI development. It is easy use, debugging ease, package services.

machine's past experiences. In simple it is defined as the extraction of knowledge from data. The goal of machine learning is to identify patterns in data and then to perform useful inference using those patterns that have been learned. [27]

Deep Learning in the cloud is accelerating enterprise AI today. SAP, IBM, nvidia, Microsofy azure, amazon web-services, Google cloud platform. Apple, DJI, banjo, Hisilicon, intel, Nvidia, open AI, Qualcomm, SenseTime, Twitter, FB, Siemens, AlBrain, Anki are some of the players in this field. Few Artificial and machine learning based startups in India are SigTuple, Aindra, Niramai Health Analytix , Advenio Technosys, Ten3T, QorQL, Touchkin, Predible Health, Healthmir, Orbuculum. [28]

AI Languages: Languages is a tool which is used to build an AI programme. LISP List Processing-Developed by John McCarthy, Sequential instructions for robots. AIML Artificial Intelligence Markup Language-Used in applications which provides smart chats. Python is very simple and can be easily learnt and easier than Java, C++, or Ruby. The languages commonly used in AI is given in **Box 2**.

Algorithms in AI: An algorithm is a set of rules given to an AI program to help it learn on its own. Well-constructed algorithms are the backbone of artificial intelligence that's intelligent.[31] The different algorithms used in machine learning application is given in **Box-3**.

Box-3. Types of Artificial Intelligence Algorithms [32]

1. Classification Algorithms
   a) Naive Bayes
   b) Decision Tree
   c) Random Forest
   d) Support Vector Machines
   e) K Nearest Neighbours
2. Regression Algorithms
   a) Linear regression
   b) Lasso Regression
   c) Logistic Regression
   d) Multivariate Regression
   e) Multiple Regression Algorithm
3. Clustering Algorithms
   a) K-Means Clustering
   b) Fuzzy C-means Algorithm
   c) Expectation-Maximisation (EM) Algorithm
   d) Hierarchical Clustering Algorithm

Commonly applied AI techniques include Neural networks, Fuzzy logic, Support vector machines, Genetic algorithms, and Hybrid systems. Artificial Neural Networks (ANNs) are operated by using algorithms to interpret non-linear data, independent of sequential pattern like a human neuron and this behaviour may be learned through a backpropagation process. The networks consist of several smaller units called neurons, organized between the input of data and the output of results into many layers. The least mean square difference of the entire data set is minimized by the continuous comparison of output of the ANN to the known output.[33]

AI and Healthcare

Computer program or software developed by emulating human intelligence could be used to assist the doctors in making decision without consulting the specialists directly or help the consultant to make wiser decision. Hoong summarized the potential of AI techniques in

medicine as provides a laboratory for the examination, screening, monitoring, organization, representation and cataloguing of medical knowledge, produces new tools to support medical decision-making, training, and research, integrates activities in medical, computer, cognitive and other sciences and offers a content-rich discipline for future scientific medical specialty.[35,36]

Pharmacy: Drug Discovery/Manufacturing, Clinical Trial Research, Radiology and Radiotherapy, Smart Electronic Health Records, Epidemic Outbreak Prediction.

Epidemic outbreak: Monitor and predict epidemic outbreaks based on data collected from social media updates, from the web, and the data collected from the satellites. ProMED-mail is used for monitoring emerging diseases and providing outbreak reports in real-time.

Appointment: Reduce the waiting time to see the specialist.

Pathology: Tissue based diagnosis [37]

Diagnosing eye disease: Expert-level diagnosis and treatment referral by a segmentation network uses a 3D U-Net architecture to create a "tissue map" of the eye from a 3D digital optical computed tomography scan. A second classification network operates on this tissue map to predict the severity of the condition. Web search giant Google is developing "Google's Deep Mind Health", technology to address macular degeneration in aging eyes.

Diagnosis and management of glaucoma: Multilayer neural networks modelled after the mammalian visual cortex capable of synthesizing images in ways that will transform the field of glaucoma. [38]

Radiology: AI methods excel at automatically recognizing complex patterns in imaging data and providing quantitative, rather than qualitative, assessments of radiographic characteristics.[39] Using CAR can save CBNAAT tests, but the radiologist's specificity was superior. [40]

Neural networks can restore limb control for the disabled: They trained a neural network to predict the likely intended movements of the person's arm based on the raw intracranial voltage signals recorded from the patient's brain.

Cancer screening: Cancer screening and treatment is an area where AI provides tremendous scope for targeted large-scale interventions. Google has developed a machine learning algorithm to help identify cancerous tumors on mammograms. Stanford is using a deep learning algorithm to identify skin cancer.[41] Somashekhar et. al. demonstrated that the IBM Watson for oncology would be a reliable AI system for assisting the diagnosis of cancer through a double blinded validation study. Esteva et. al. analysed clinical images to identify skin cancer subtypes.[42]

Breast cancer screening: AI system that outperforms radiologists on a clinically relevant task of breast cancer identification.[43]

GIT: Artificial Intelligence is being used to diagnose the presence polyps on the colon during a colonoscopy.

Diabetic Retinopathy (DR) screening: NITI Aayog is working with Microsoft and Forus Health to roll out a technology for early detection of diabetic retinopathy as a pilot project. Integrating AI capabilities to this device using Microsoft's retinal imaging APIs enables operators of Nethra device to get AI-powered insights even when they are working at eye check-up camps in remote areas with nil or intermittent connectivity to the cloud. Additionally, Alphabet Inc's collaboration Aravind Eye Hospital, Narayana Nethralaya and Sankara Nethralaya to test and deploy an AI system for diabetic retinopathy detection has attracted a lot of attention. Google has developed an artificial intelligence model that can detect diabetic retinopathy by analyzing the scans of the retinas - the region at the back of the eye - using special cameras. Google and Verily—Alphabet's life sciences and healthcare arm have developed a machine learning algorithm to make it easier to screen for disease, as well as expand access to screening for DR and DME. [44]

Cardiovascular disease: The University of Sydney's Westmead Applied Research Centre is working on a digital health program for people at risk of cardiovascular disease. Detecting and classifying cardiac arrhythmia using ECGs: A single lead electrocardiogram traces in the ambulatory setting can be processed in a raw format by a deep learning model to detect 12 rhythm classes.

Cardiac imaging for the assessment of myocardial ischaemia: SPECT is most used for clinical myocardial perfusion imaging, whereas PET is the clinical reference standard for the quantification of myocardial perfusion using a real-time Delphi process. [45]

COPD: AI aided lung imaging that use AI and high-resolution CT scans or Xray images along with advanced Computational Fluid Dynamics (CFD) tools to help pulmonologists visualize both structural and functional parameters of the lungs. [46]

Sustainable Development Goals: Using a consensus-based expert elicitation process, we find that AI can enable the accomplishment of 134 targets across all the goals, but it may also inhibit 59 targets. [47]

Sudden Infant Death Syndrome: Seattle Children's Research Institute uncover the root causes of breathing disorders like SIDS (sudden infant death syndrome).

Eliminate leprosy: Microsoft and the Novartis Foundation are developing an AI-enabled digital health tool, which can accelerate early detection, helping the world toward leprosy elimination. The Cascadia Data Discovery Initiative (CDDI), led by the Fred Hutchinson Cancer Research Center and powered by Microsoft, aims to establish a regional data sharing ecosystem.[48]

Neurology: Bouton et al. developed an AI system to restore the control of movement in patients with quadriplegia.[49] Farina et al. tested the power of an offline man/machine interface that uses the discharge timings of spinal motor neurons to control upper-limb prostheses. [50]

Cardiology: Dilsizian and Siegel discussed the potential application of the AI system to diagnose the heart disease through cardiac image. Arterys recently received clearance from the US Food and Drug Administration (FDA) to market its Arterys Cardio DL application, which uses AI to provide

automated, editable ventricle segmentations based on conventional cardiac MRI images. [51]

Neural networks decode your thoughts from brain waves: Researchers reconstruct speech from neural activity in the auditory cortex.

Neurodevelopmental disorders: The NDDs are a group of early childhood onset disorders that impact different domains of cognitive development, motor function and other higher brain functions, and are lifelong in nature. Precision medicine is a healthcare pathway that employs numerous technologies to guide individually tailored diagnosis and treatment for patients.[52]

Detection of anaemia from retinal fundus images: Detect anaemia and quantify Hb measurements, potentially enabling automated anaemia screening using fundus images.[53]

Rural health: Rafael Figueroa, an entrepreneur from Brazil, created Portal Telemedicine to help address this problem. Now, more than 500 rural clinics and large healthcare institutions throughout Brazil and Angola use Portal's technology. [54]

Tuberculosis: A convolutional neural networks (CNN) model, named tuberculosis AI (TB-AI), specifically to recognize TB bacillus helps to detect stained TB bacilli and help make clinical decisions. [55] El-Solh et al., claimed that they were the first to implement an AI technique for diagnosing TB. Later, many different approaches were utilized to achieve maximum accuracy to diagnose TB. [56,57]

Medication adherence is of utmost importance for many chronic conditions. By categorizing the different digital health solutions by the four functions identified in the WHO "agenda for action" for digital health in TB. These includes identification presumptive TB cases (social media, LTBI app, HCW app), Diagnose TB patient (diagnostic connectivity, TB help line), Enrol a TB patient (patient education application, clinical decision support, electronic patient register) and provide Tb care and support (VOT, EMM, drug quantification tool). [6] This will help to in end TB strategy through nine priority digital health concepts.[58]

Some of the agencies include AiCure, AbbVie and NeuroBo, Brite Health, Medisafe, Boehringer Ingelheim and Apple Health Records and Proteus Digital Health used smart pills (ingestible digital sensors) with built-in machine learning capabilities that track medication adherence. Partners include Novartis and Otsuka.[59] Late doses triggered notifications within the hour and prior to the end of the dosing window. Clinic staff received automated text messages or emails if doses were missed, late, or based on incorrect usage.[60]

Discussion

We have reviewed the basics of AI and adoption of AI in various fields. It recognizes that digital health can radically change health outcomes as it improves the efficiency and cost effectiveness of care, allowing for new business models in the delivery of services.[61] Digital health expands the concept of eHealth to include digital consumers, with a wider range of smart-devices and connected equipment. The application of AI in medicine remains a hot topic of keen interest for researchers and is under constant development and refinement. AI can be used medical education to make curriculum assessment, improvement of students' learning and assessments.[62]

The rise of artificial intelligence (AI) in the era of big data could assist physicians in shortening processing times and improving the quality of patient care in clinical practice.[63] The advantages of Artificial intelligence applications are enormous

and can revolutionize any professional sector. Human errors are reduced much through this system. It can take risky jobs where humans can't work with. It is available round the clock and help our task day today life. It helps us to make better decision quick and to make new interventions. Need to pay more for any specific services and it is much complex to understand. One need to invest more setup an AI in line with hardware and professional services. Moreover, AI does not have full emotion of feeling as human. Some fears it leads to unemployment. [64]

Conclusion

Artificial intelligence is expected to be game changer in future health care sector in India. The AI technology to be made available through public and private health sectors so it can be accessible to wider population. An AI policy can be formulated by the Government will help many start-ups which can access public data and create the expected algorithm using machine learning.

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Conflict of Interest : **None**

Source of funding support : **Self-funded**

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